Conversion to LNG

Challenges and Opportunities for Washington State Ferries

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Royal Norwegian Embassy Seminar
Feb. 28, 2013

System Overview

- More than 22 million riders per year
- 10 million vehicles carried per year
- Fleet of 23 ferries that carry 34-202 cars and 750-2,500 passengers
- 20 terminals on 10 routes
- 450 daily departures
- 1,800 employees

World Leader

- Largest system in the United States
- Fourth largest carrier of passengers in the world
- Largest carrier of vehicles in the world

Route Characteristics

Route	Commuter	Tourist	Island link	Commercial
Anacortes/Sidney		✓		
Anacortes/San Juan Islands		✓	✓	✓
Port Townsend/Coupeville		✓	✓	✓
Mukilteo/Clinton	✓	✓	✓	✓
Edmonds/Kingston	✓	✓		✓
Seattle/Bainbridge Island	✓	✓		
Seattle/Bremerton	✓	✓		
Fauntleroy/Vashon/Southworth	✓		✓	✓
Point Defiance/Tahlequah	✓		✓	

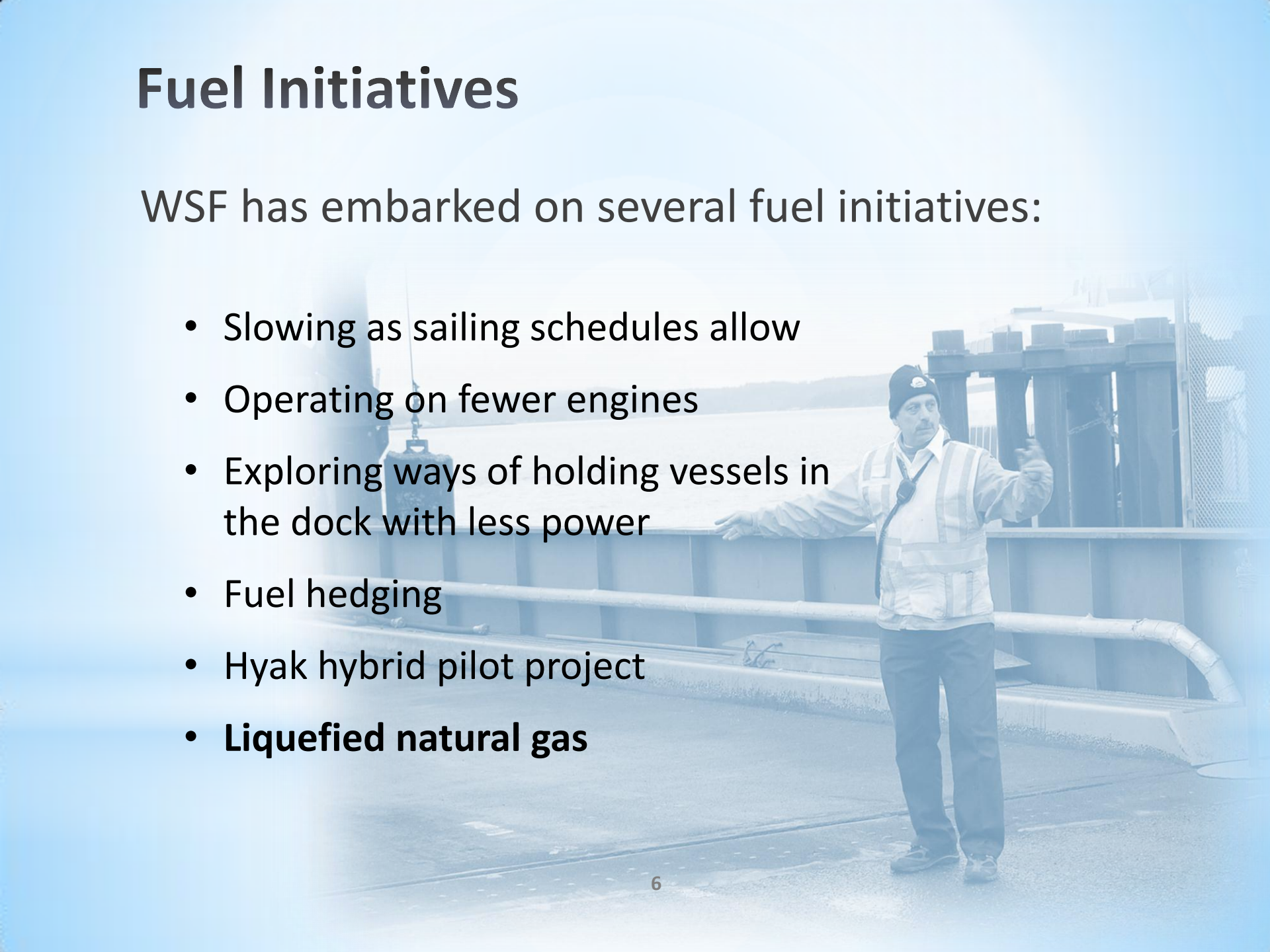
Fuel Costs

- WSF burns more than 17 million gallons of ultra-low sulfur diesel each year.
- Fuel is the fastest growing operating expense – more than 29% of 2011-2013 budget compared to 12% in 2000-2001.
- WSF's 2013 fuel budget is $74.3 million – $58.7 million more than 13 years ago.

Fuel Initiatives

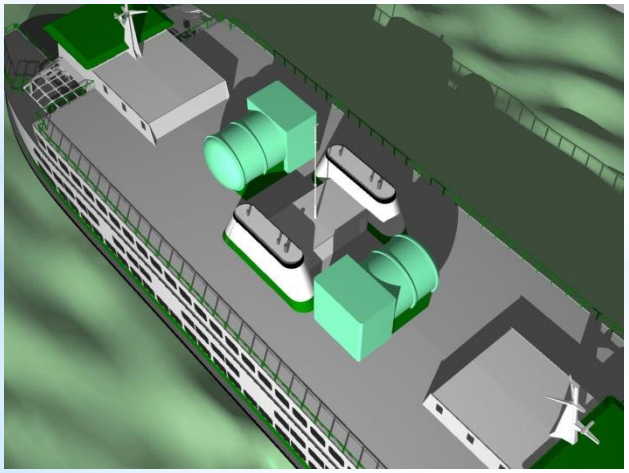
WSF has embarked on several fuel initiatives:

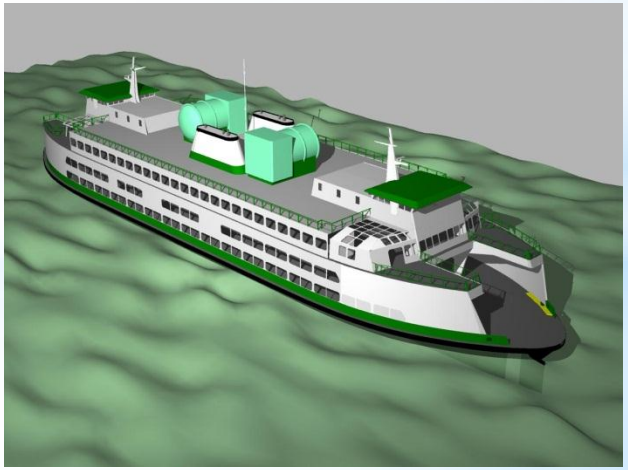
- Slowing as sailing schedules allow
- Operating on fewer engines
- Exploring ways of holding vessels in the dock with less power
- Fuel hedging
- Hyak hybrid pilot project
- **Liquefied natural gas**



Exploration of LNG

- WSF is exploring an option to use LNG as a source of fuel for propulsion.
- This is an opportunity to reduce fuel costs and decrease emissions.
- Conceptual approval has been received from the U.S. Coast Guard to retrofit propulsion systems with new engines on all six Issaquah Class ferries.
- U.S. Coast Guard ruled LNG not considered a major conversion.





Potential Fuel Savings

Issaquah Class

Vessel	Usual Route	3-year Avg. Annual Diesel Gallons
Issaquah	Fauntleroy - Vashon – Southworth	601,000
Kitsap	Seattle - Bremerton	755,000
Kittitas	Mukilteo - Clinton	450,000
Cathlamet	Mukilteo - Clinton	514,000
Chelan	Anacortes - Sidney	764,000
Sealth	Anacortes – Friday Harbor	633,000
Total average annual diesel gallons		3,717,000
85% of diesel gallons converted*		3,159,000
Projected Annual savings (approx. $2/gal. of diesel replaced)		$6.4 million
Projected LNG gallons		5,370,000

* Approximately 15% diesel remaining for ship service and emergency generators

Overall Financial Benefits

Project Element (dollars in millions)	Discounted Values (3% Discount Rate)
Six Issaquah Class Vessels NPV Fuel Savings for 23-25 years	$112.1
Social Benefits of Carbon reduction	$5.3
Social Benefits of particulate matter reduction	$61.3
Social Benefits of NOx reduction	$21.7
Total Benefits	**$200.5**
Design	$0.3
Shipyard Contract and Integrator	$36.5
Construction Engineering	$0.9
Owner Furnished Equipment	$34.6
Risk and Escalation	$8.9
Total Costs	**$81.2**
Benefit Cost Ratio	**2.47**
NPV, fuel + emission benefits	**119.2**
NPV, fuel benefits only	**$30.9**
ROI, fuel + emission benefits	**8.5 years**
ROI, fuel only	**14 years**
Average Annual fuel savings per vessel	**$1.1 million**

Challenges of Retrofit - Physical

- Upper deck tank location reduces available space for passengers on classes other than Issaquah
- Fuel lines run in existing casing in a double wall configuration; bunkering from main deck requires pumping LNG from truck to upper deck
- Installation of new gas engines:
  - Gas engines are larger and heavier
  - Engine performance – critical for maneuvering, crash stop, acceleration – is lower for a gas engine than a diesel engine
- Maintaining system safety with the use of a cryogenic fluids as fuel. Handling and storage of LNG requires:
  - Double-walled piping, double-walled tanks and cold box for leak containment
  - Ventilation and gas supply monitoring
  - Nitrogen purge system for gas supply and lines
  - Dry chemical fire extinguishing system
- Dependable access to reasonably priced LNG sources is critical to successful conversion

Tank Location on Upper Deck

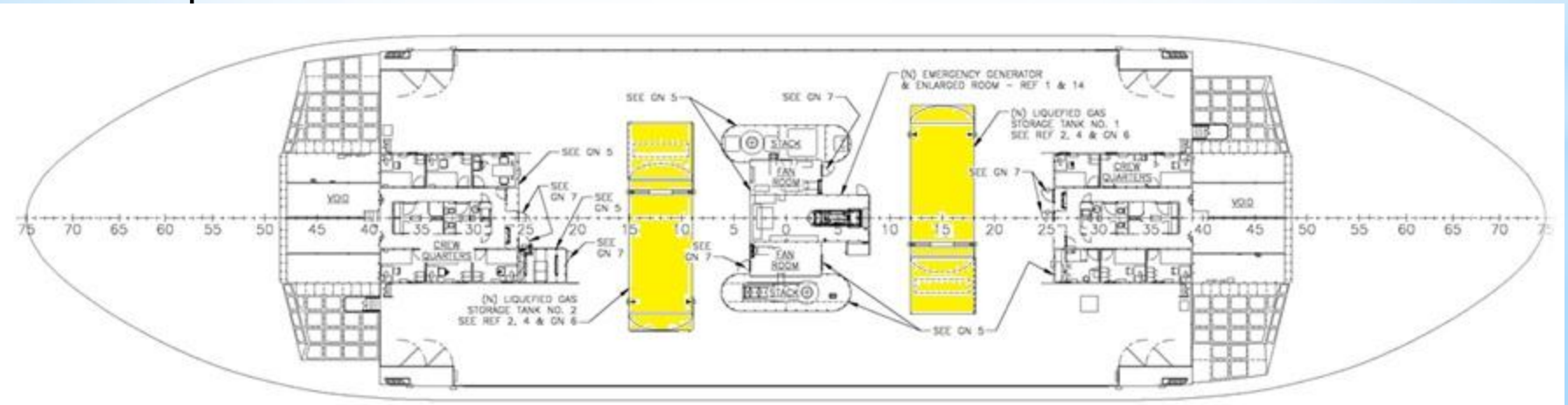
Issaquah Class

Advantages

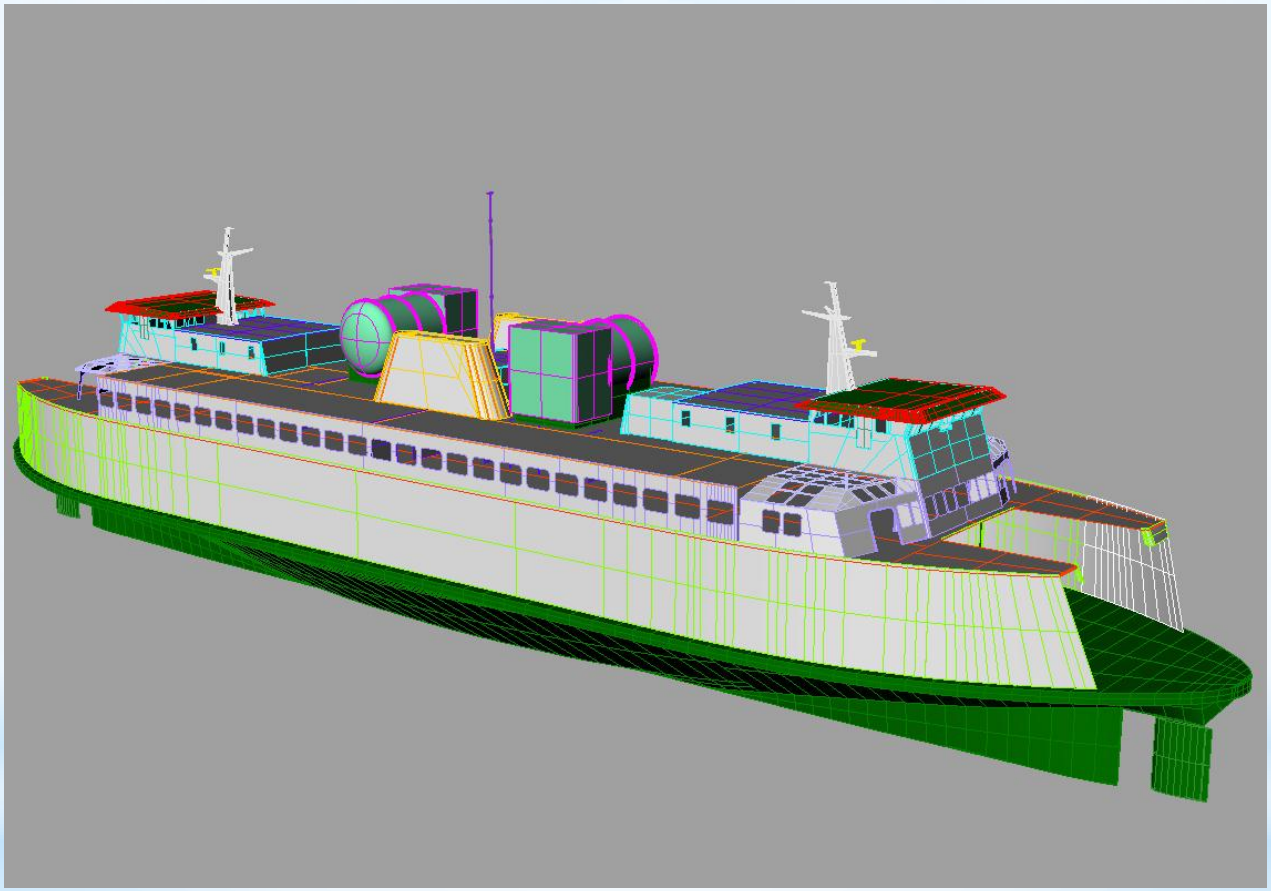
- Ease of Installation: no major structural modifications
- Leaks naturally dissipate into the atmosphere
- Maintenance
  - Easy access to all components
  - Flexible arrangement of piping and vent systems
- Area is isolated from passenger space on Issaquah class

Disadvantages

- Bunkering requires a dedicated cryogenic pump
- Glycol vaporization system run from the engine room
- Tanks separated from the engine room crew
- Pumping LNG adds heat to the fluid reducing the fueling rate



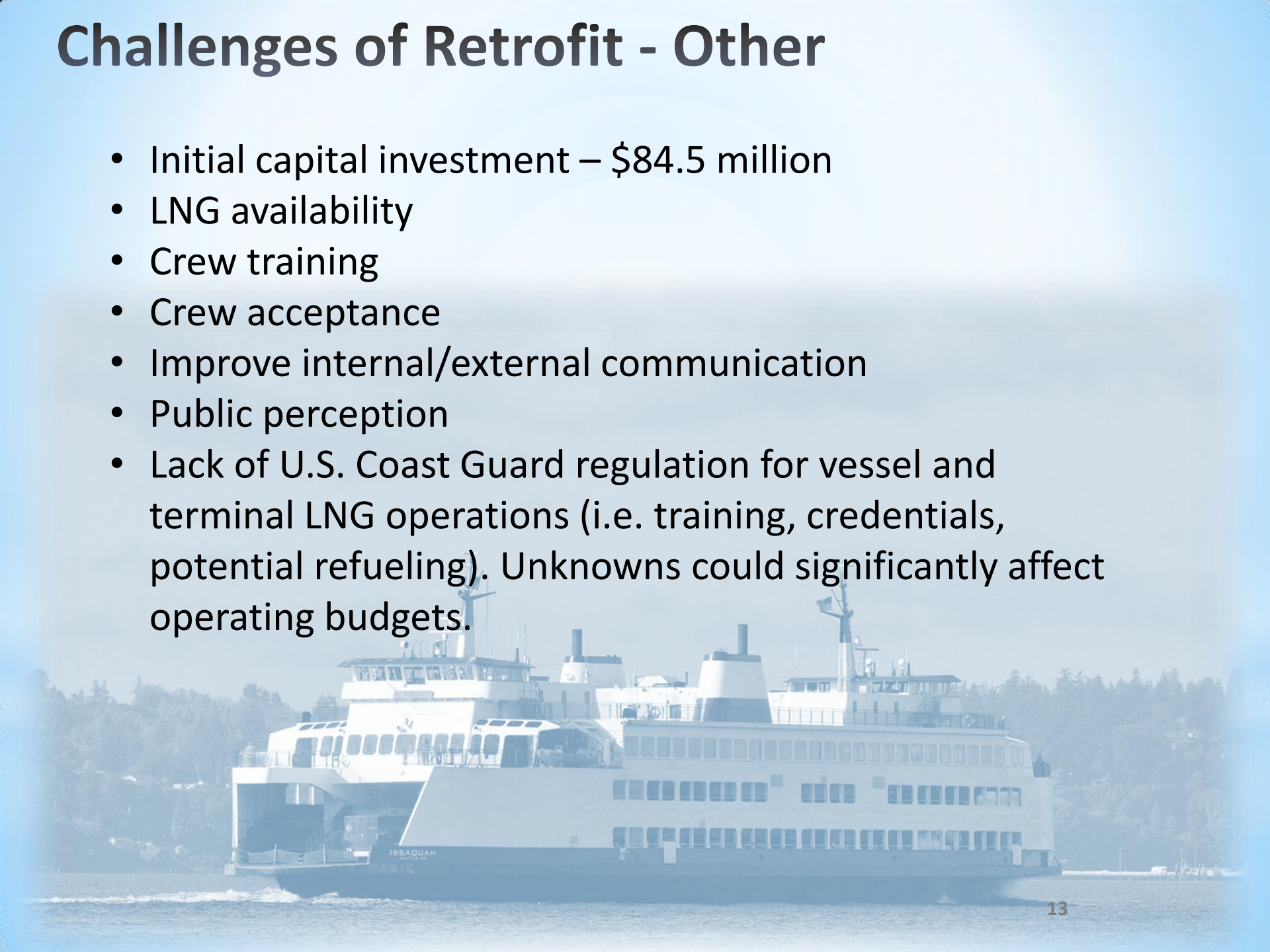
Above Deck Arrangement



Two tanks: 24,440 gallons each. Total: 48,880 gallons

Challenges of Retrofit - Other

- Initial capital investment – $84.5 million
- LNG availability
- Crew training
- Crew acceptance
- Improve internal/external communication
- Public perception
- Lack of U.S. Coast Guard regulation for vessel and terminal LNG operations (i.e. training, credentials, potential refueling). Unknowns could significantly affect operating budgets.



Next Steps

- Complete Safety and security assessments and plans
- Obtain U.S. Coast Guard approval for detail design
- Complete final design
- Obtain Funding for retrofit construction
- Train crews

Questions?

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